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ABSORBENCY CHARACTERISTICS OF PESHTAMALS: TRADITIONAL TURKISH WOVEN CLOTHES

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Abstract: *Absorbency of textiles is defined as the ability of taking in a fluid in the manner of a sponge. Absorbency is required for comfort properties in some clothes such as sportswear and underwear clothing, for drying properties in napkins, towels and bathrobes, for health concerns in some medical textiles such as bandages, gauze and absorbent cotton, and for cleaning properties in washclothes and mops. In this study five different fabric samples (three woven 100% cotton fabrics A, B and P respectively at plain, twill, and peshtamal weaving patterns and two 100% cotton terry towels T1 and T2) were tested. The absorbency properties of the samples were evaluated according to the droplet test, sinking time test and wicking height tests (pottasium chromate test). Peshtamal samples showed better absorbency results than plain and twill weaves and lower but close results to towel samples according to the droplet test, sinking time test and wicking height tests. The absorbency properties of peshtamals showed results close to towel samples. The void content of peshtamals is higher than plain and twill samples but closer and lower than towel samples. The good absorbency results of peshtamals might be due to the void content of peshtamals which is higher than plain and twill samples but closer and lower than towel samples. Peshtamals which are good in absorbency and light in weight might be used widespreadly in daily life for their high absorbency, and on travel for weight saving purposes.*

Key words: *absorbency, hydrophility, peshtamal, towel, porosity.*

1. INTRODUCTION

Peshtamals, having a specific weaving pattern, are traditional Turkish clothes that had been used in Turkish hammams during history for their absorbency properties until towels immerged. Peshtamals are still being used in homes and in Turkish hammams for their absorbency ability. Peshtamals are accepted as the ancestor of terry woven towels; peshtamals have long yarn floats, which resemble towel loops, on their weaving pattern.

Absorbency of textiles is defined as the ability of taking in a fluid in the manner of a sponge. Absorbency is required for comfort properties in some clothes such as sportswear and underwear clothing, for drying properties in napkins, towels and bathrobes, for health concerns in some medical textiles such as bandages, gauze and absorbent cotton, and for cleaning properties in washclothes and mops. There are studies on wettability of textiles and absorbency studies on textile materials which date as back as 1950s [1-9].

Buras et al (1950) offered a new absorbency testing method for fabrics which numerically evaluates rate of absorption and ultimate absorption values of fabrics, and also eliminates timing procedures. Uniform absorbency of textiles is necessary to have uniform printing and uniform dyeing during finishing processes of textile fabrics, due to the importance of absorbency in many textile products and production processes, the evaluation of absorbency is essential [1].

There are number of well-defined methods of testing textile absorbency and according to Ehrler et al (1983) the results obtained with different tests do not correlate with each other, and none of the tests has always provided all of the information needed. Textile fibers wetting behaviors are affected by their surface roughness, fiber type and blend ratios, liquid adsoption and surfactant adsorption. Wetting is the displacement of a fiber-air interface by a fiber-liquid interface [2].

Cary and Sproles (1979) compared several absorbency test methods for terry towels. They concluded that a towel does not need only a high rate of absorbency, but a towel has both a quick rate of absorption and a reasonable capacity of absorbency. Some absorbency tests were eliminated as they only measure capacity. Porous plate and sliding block tests are suitable for towel absorbency tests but the porous plate tends to clog by time due to lints of towels and the sliding block method is a very complex testing method. Testing methods have strengths and limitations in some senses for towel absorbency testing [3].

Ozturk et al (2011) evaluated the wicking properties of cotton-acrylic rotor-spun yarns and concluded that the increase in acrylic content increased the wicking ability of fabrics. The better wicking ability of acrylic yarns might be due to their lower moisture absorption of acrylic compared to cotton. Water diffuses into cotton fiber, and cotton fiber swells. On the other hand, water movement and absorption occurs only on the acrylic fiber's surface [4].

Hasan et al (2008) investigated the surface properties and wetting properties of plain and twill woven polyester fabrics. They investigated the relationship between the topographic structure of the fabrics and their wetting properties. They found that fabrics made of fibers at cruciform cross sections are more hydrophobic than the fabrics made of fibers with round cross sections [5].

According to Kissa (1981), wettability is a prerequisite for absorption. Wettability is defined as the initial behavior of the fabric, yarn or fiber when brought into contact with liquid. Wetting is the prerequisite for wicking. The contact angle is useful in determining the wetting tendency of fibers in a fabric, but the contact angle may be difficult to measure and hard to obtain accurate results due to the complex surface structure of fabrics [6].

Murphy and Macormac (1958) investigated the absorbencies of undyed towel samples against laundering. They observed an increase until 100 washing cycles in the ultimate absorptions [7].

Lord (1974) compared the wicking height and wicking volume of open-end yarns and ring yarns used in Terry towel production. Lord observed that open-end and ring yarns having same yarn counts and similar twist amounts have nearly the same ultimate wicking volume; and open-end yarns wick better and more evenly than ring yarns [8].

Miller and Tyomkin (1984) investigated the transplanar liquid uptake of fabrics and developed a gravimetric method to measure the total rate of transplanar liquid absorption [9].

2. EXPERIMENTAL APPROACH

In this study totally five different samples were evaluated according to their absorbency properties. Two terry towel samples T1 and T2 and three samples of woven fabrics A, B and P respectively at plain weave (1/1), twill weave (2/1 Z twill fabric), and peshtamal weaving patterns were used in this study.

2.1 Materials and Method

Woven fabrics A, B and P were woven on the same projectile weaving machine using the same weft and warp yarns to avoid absorbency differences due to material variance. The densities of the weft yarns and the warp yarns were kept same during production of fabrics A, B and P to eliminate effect of fabric composition. Samples A, B and P had the same number of weft and warp densities as well as the same weft and warp counts. Terry towel samples T1 and T2 were obtained from local towel producers. All the samples were greige goods and were desized and scoured. The fiber content, yarn densities, yarn counts, fabric weights and porosities of the fabric samples used in this study are given for woven samples and towel samples respectively in Table 1.a. and Table 1.b.

Table 1.a. *Properties of woven fabric samples used.*

designation of fabric	description of fabric	fiber content	yarns per cm		weight (g/m^2)	porosity (%)
			warp	filling		
A	Plain weave	100% cotton	15	14	161	83,5
B	Twill (2/1 Z)	100% cotton	15	14	162	88,7
P	Peshtamal	100% cotton	15	14	164	91,4

Table 1.b. *Properties of towel fabric samples used.*

designation of fabric	**description of fabric**	**fiber content**	**yarns per cm**			**weight (g/m^2)**	**Porosity (%)**
			terry warp	**binder warp**	**filling**		
T1	Terry towel	100% cotton	8	15	17	420	91,5
T2	Terry towel	100% cotton	8	17	20	500	94,8

The point diagrams of samples A, B and P are given in Figure 1.

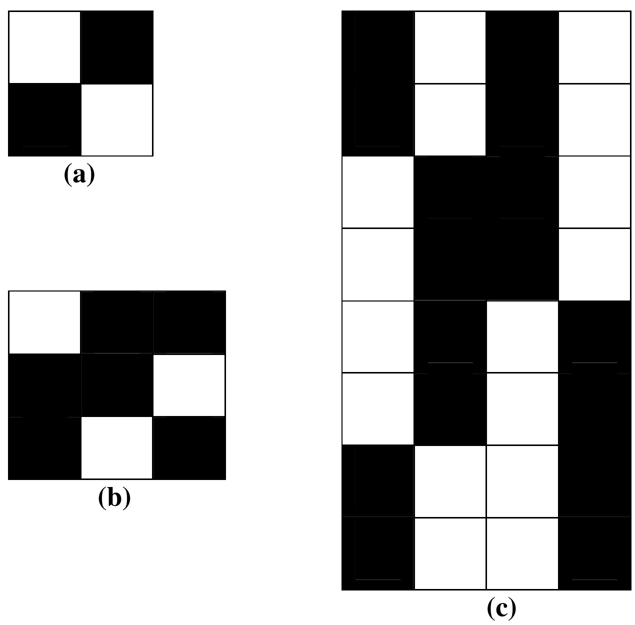

Fig. 1: *Point diagrams of samples (a) A, (b) B and (c) P.*

Ozturk et al concluded that fiber composition was the most important variable affecting yarn wicking, another statistically important variable affecting yarn wicking was yarn count [4]. Using the same weft yarns and same warp yarns, in this study we eliminated the effect of fiber composition and yarn count.

The porosity values of the samples, taking the specific density of cotton fiber as 1,54 g/cm^3, are calculated using the following equations 1 through 3:

$$porosity\ \% = 1 - pf \qquad (1)$$

$$pf = \frac{d_{fabric}}{d_{fiber}} \qquad (2)$$

$$d_{fabric} = \frac{w_{fabric}}{t_{fabric}} \qquad (3)$$

where:

$pf = packing\ factor$

$W = weight$
$t = thickness$
$d = density$

Absorbency tests of the samples were measured with three different methods: droplet test, sinking time test and wicking tests using the standard test methods respectively: TS 866, TS 866 and DIN 53924.

Droplet test was conducted according to Turkish Standard TS 866. In the droplet test, the textile product is attached to a hoop with a diameter of at least 15 cm in a stretched manner. Droplets are dropped one per 5 seconds from the burette above 1 cm of the sample. Time passed during the droplet disappears is measured using a chronometre. At least 10 measurements are needed and their arithmetic mean is taken as the result. For bleached cotton materials results from 0 sec to 2,5 sec is rated very good; results from 2,5 sec to 5 sec is rated as average and results above 5 sec is rated as low hydrophility degree.

Sinking time test was conducted according to Turkish Standard TS 866. In sinking time test the material is released from 10 mm height onto the water surface. As one side of the textile material touches to water surface, at that moment time is watched and the time passing until all the sample is wetted and immersed is noted. At least three measurements are needed. Results from 0 sec to 50 sec is regarded as very good, results from 50 sec to 100 sec is regarded as average and results from 100 sec to above results is regarded as low hydrophility degree.

The wicking tests (potassium chromate test) were conducted according to DIN 54924 standard, in which an edge of the test material is plunged into 1% potassium chromate solution. The distance covered by the solution in 10, 30, 60 and 300 seconds is determined by means of a ruler. Test is completed for both warp and weft directions for at least 5 samples and arithmetic mean is taken as result. If the wicking height result is less than 10 mm, hydrophility is noted as low; if height is between 10-30 mm, hydrophility is average and if result is above 30 mm, then hydrophility is regarded as very good.

2.2 Results

The absorbencies of the samples are tested according to droplet test, sinking time test and wicking tests. The droplet test results (TS 866) are given in Table 2, Table 3 and Table 4. According to droplet test results, sample A has low absorbency, samples B and P have average absorbency and T1 and T2 samples have good absorbencies.

Table 2. *Droplet test results*

designation of fabric	time (sec) ± standard deviation
A	5.13 ± 0.61
B	3.24 ± 0.26
P	2.96 ± 0.17
T1	1.02 ± 0.11
T2	0.86 ± 0.05

The absorbency results of sinking time tests given in Table 3 (TS 866) rate all the samples' absorbencies as “very good”; while the wicking test results given in Table 4a and 4b (DIN 53924) rate all the samples absorbencies as “low”.

Table 3. *Sinking time results*

designation of fabric	Sinking time (sec) ± standard deviation
A	16.90 ± 3.36
B	16.78 ± 1.62
P	11.84 ± 0.30
T1	12.21 ± 1.81
T2	9.08 ± 0.30

Table 4.a. *Wicking results in warp direction*

designation of fabric	Wicking height in warp direction ± **standard deviation**			
	10 sec	30 sec	60 sec	300 sec
A	0.97 ± **0.15**	2.31 ± **0.23**	3.50 ± **0.19**	7.65 ± **0.64**
B	1.24 ± **0.20**	3.08 ± **0.12**	4.55 ± **0.22**	8.70 ± **0.12**
P	1.73 ± **0.20**	3.70 ± **0.36**	5.12 ± **0.38**	8.75 ± **0.24**
T1	1.04 ± **0.23**	2.78 ± **0.33**	4.08 ± **0.13**	7.41 ± **0.16**
T2	0.71 ± **0.12**	1.93 ± **0.42**	3.20 ± **0.42**	4.86 ± **0.48**

Table 4.b. *Wicking results in weft direction*

designation of fabric	Wicking height in weft direction ± **standard deviation**			
	10 sec	30 sec	60 sec	300 sec
A	0.37 ± **0.07**	1.82 ± **0.43**	3.12 ± **0.34**	7.04 ± **0.38**
B	0.56 ± **0.07**	1.70 ± **0.11**	3.01 ± **0.15**	7.00 ± **0.27**
P	0.68 ± **0.17**	2.05 ± **0.36**	3.48 ± **0.37**	7.61 ± **0.24**
T1	1.45 ± **0.48**	2.76 ± **0.71**	3.80 ± **0.37**	6.20 ± **0.18**
T2	1.31 ± **0.14**	2.77 ± **0.20**	3.67 ± **0.18**	5.25 ± **0.17**

3. CONCLUSIONS

According to droplet test results, plain weave has low absorbency, twill weave and peshtamal have average absorbency and towel samples have good absorbencies. The absorbency results of sinking time tests rate all the samples' absorbencies as "very good"; while the wicking test results rate all the samples absorbencies as "low". The water droplet method has validity problems in the manner of sensitive measurements for towels while the wicking height method is useful to make rough comparisons between towels. However, the wicking height method is not sufficient for research applications since the water rises only on the binder warp and this makes it hard to make sensitive comparisons between towels [3].

Although results of the three test methods don't correlate to each other, the rank in absorbency for samples is the same for all tests. Peshtamal samples showed better absorbency results than plain and twill weaves and lower but close results to towel samples according to all of the three testing methods.

Buras et al concluded that absorption was based mainly on the spaces within the fabric rather than on the fabric itself [1]. Hasan et al concluded that the plain weave has lower porosity and as a consequence a lower water absorption value [5].

Peshtamal samples have better absorbency results than plain and twill weaves and lower but close values to towel samples. This might be due to the void content of peshtamals which is higher than plain and twill samples but closer and lower than towel samples. Peshtamals which are good in absorbency and light in weight might be used widespreadly in daily life for their high absorbency, and on travel for weight saving purposes.

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